024-Attention&Space-3

# A new approach in the treatment of Optic Ataxia: evidence from a single case study

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## Background and Aims

- **Optic ataxia (OA)** is a visuospatial deficit characterized by difficulties in reaching/grasping visual targets presented in the peripheral side of the visual field, consequent to lesions of the superior parietal lobule and/or of the intraparietal sulcus.
- **Prismatic Adaptation (PA)** is a widely used technique in the rehabilitation of visuospatial deficits (e.g., neglect), but findings supporting its application in patients with OA are conflicting [1], [2].
- **MindLenses Professional,** a new tool combining PA with digital cognitive tasks (*serious games* - SG) has been applied for the rehabilitation of both visual and cognitive deficits in neurological patients.

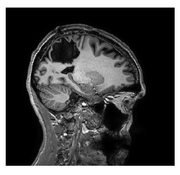
Here, we report for the first time the effects of a treatment using MindLenses in a patient with OA consequent to a hemorrhagic stroke of the left posterior regions.

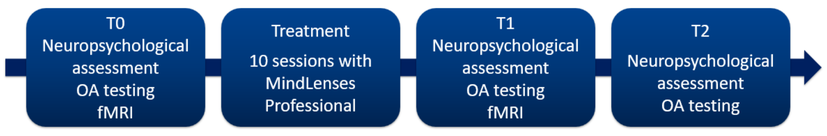
The **main aims** were to investigate whether: 1) the treatment could induce long-lasting improvements in OA and in cognitive deficits, as measured immediately and three months after the end of the treatment; 2) the patient was able to adapt to the visual shift induced by PA; 3) the treatment could induce functional brain changes at the fMRI.

## Methods

### Case description - BC

- 51 years-old woman
- Left parieto-occipital lesion consequent to haemorrhagic stroke (2 months earlier)
- Optic ataxia






**OA testing** (adapted from [3])**:** Wooden pole presented at random at either left / right visual hemifields. Participant had to grasp the object (left / right hands) while maintaining central fixation. 20 trials in 4 conditions (Fig. 1).

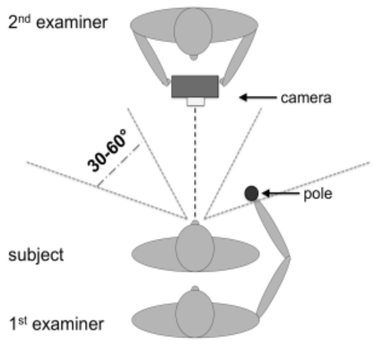



Figure 1. Procedure of the OA testing [3]

**Neuropsychological Assessment:** administered to assess BC cognitive performance before the treatment (T0), immediately after (T1) and at three months (T2).

**MindLenses**

10 sessions (5 per weeks) of PA leftward deviating prisms followed by 20 min of SG (Fig. 2)

PA: pointing task including pre-exposure, exposure and post-exposure conditions. PA performance was evaluated as the mean of the displacement (cm) for each of these conditions during the 10 sessions of treatment. The after-effect was calculated as the difference between pre- and post-exposure.

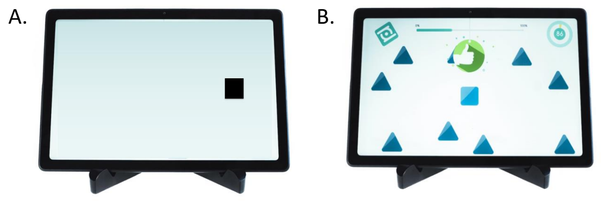



Figure 2. Examples of (a) pointing task and (b) serious game (visual search) on MindLenses's tablet

**fMRI analysis:** functional resting state data were collected on a 3T Scanner (number of volumes = 421, TR = 2100ms, voxel size = 1.96 × 1.96 × 2.4mm). To determine if any significant changes occurred in connectivity, a delta connectivity matrix was obtained from the subtraction between the post and pre-treatment matrices. Connectivity changes above or below 0.5 SD were considered.

## Results

1) BC showed deficits in attention, executive functions, calculation and visuospatial abilities. At T1 and T2, improvements were observed in visuospatial abilities, attention, language and set-shifting. (Tab. 1). Similarly, improvements in OA were observed both at T1 and T2 (Fig. 3).

| | PRE | POST | FOLLOW-UP |
|---|---|---|---|
| MMSE | 22.97 | **25.97** | 22.97 |
| Complex figure – copy | 25.25 | **30.25** | **31.25** |
| Complex figure - recall | 21,5 | 24,5 | 23 |
| Phonological fluency | 23 | **32** | 21 |
| Semantic fluency | 17 | **35** | **44** |
| TMT-A | 85 | **65** | **37** |
| TMT-B | 365 | **207** | **149** |
| Spatial span | 2.99 | 1.99 | 3 |
| Spatial supraspan | 21.08 | 25.23 | 19.9 |
| NADL Informal test | 19 | 17 | 17 |
| NADL Formal test | 18 | 21 | 20 |

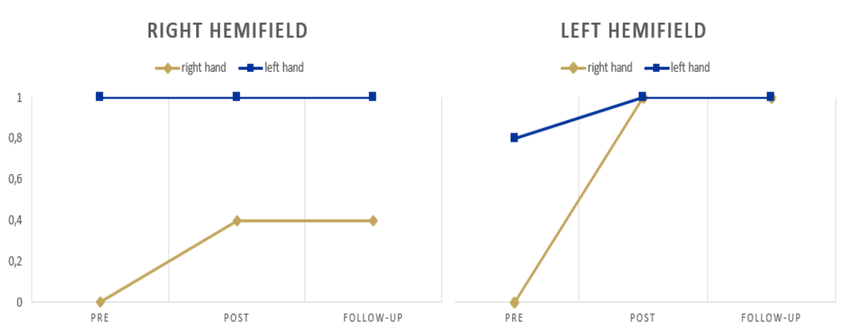



Figure 3. Performances at the OA task for each condition and time point.

2) Throughout the 10 sessions, during prismatic exposure, BC adapted to the leftward induced shift. After exposure, PA induced a contralateral (right hemifield) after effect (Fig. 4).

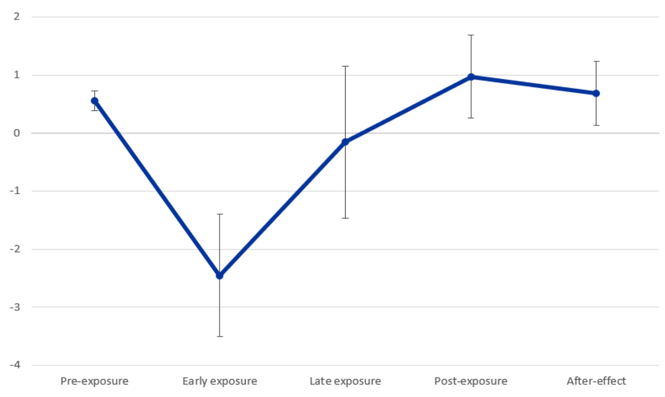



Figure 4. Mean scores (cm) of displacement at the pointing task in the three conditions during the 10 sessions of treatment

3) Preliminary results on fMRI data showed a functional re-organization of brain connectivity, with increase intra and inter-hemispheric connectivity in perilesional areas. Additionally, an increase in inter-network intra-/inter-hemispheric connectivity was found (Fig. 5a), whereas decreased connectivity was observed mainly in inter-network inter-hemispheric connections (Fig. 5b).

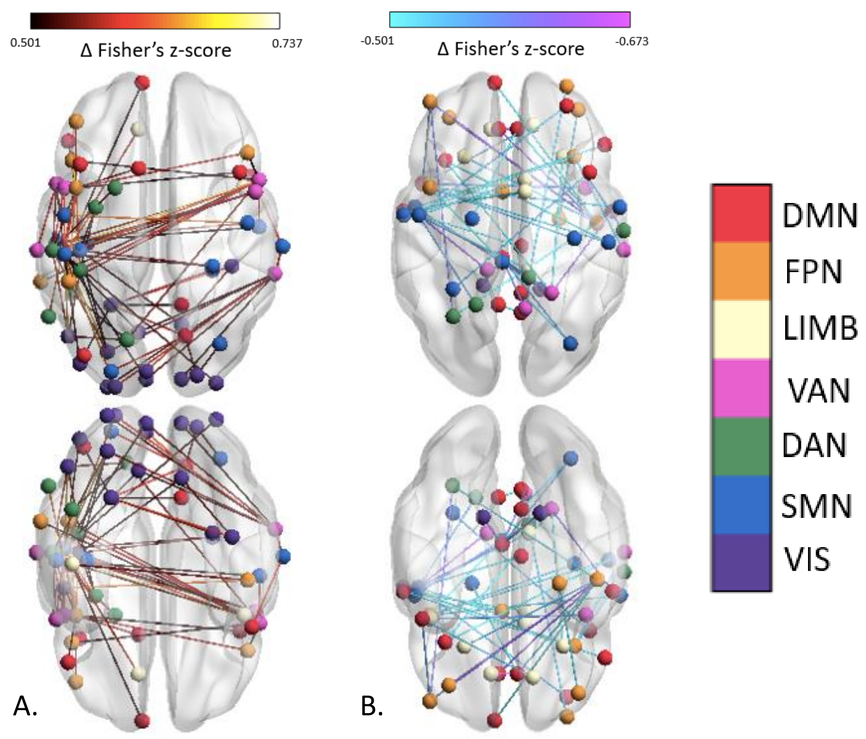



Figure 5. (A) Increase and (B) decrease in brain connectivity after the treatment. ROIs are presented in colors, according to the legend

## Discussion and implications of findings

- The treatment with MindLenses induced **improvements in OA and in some cognitive deficits, as well as changes in functional brain connectivity**.
- BC exhibited both adaptation to the visual shift and after-effect. This result confirms previous findings reporting adaptation to prismatic deviation in OA [1]. Probably, preserved contralateral parietal lobe and cerebellum allowed the visuo-motor adaptation observed in BC.
- The improvement in cognitive performance could be due to both the generalization of the PA effect [4] and the administration of SG. These changes, as well as changes in functional brain connectivity, might be supported by the neuromodulatory effect exerted by PA on the fronto-parietal network [5].

In conclusion, MindLenses Professional may be an effective tool to rehabilitate both cognitive and visuospatial deficits. Future studies could expand these results by applying the device to wider samples and by taking into consideration other cognitive deficits.

## References

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